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ENERGY SYSTEMS GROUP
ENVIRONMENTAL MONITORING
AND
FACILITY EFFLUENT
ANNUAL REPORT
1981

Rockwell International

Energy Systems Group
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ENERGY SYSTEMS GROUP ENVIRONMENTAL MONITORING AND FACILITY EFFLUENT ANNUAL REPORT 1981

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ABSTRACT

Environmental and facility effluent radioactivity monitoring at the Energy Systems Group (ESG) of Rockwell International (California operations) is performed by the Radiation and Nuclear Safety Group of the Health, Safety and Radiation Services Department. Soil, vegetation, and surface water are routinely sampled to a distance of 10 miles from ESG sites. Continuous ambient air sampling and radiation monitoring by thermoluminescent dosimetry are performed on-site for measuring airborne radioactivity concentrations and site ambient radiation levels. Radioactivity in emissions discharged to the atmosphere from ESG facilities is continuously sampled and monitored to ensure that the amounts released to unrestricted areas are within appropriate limits and to identify processes that may require additional engineering safeguards to minimize radioactivity in such discharges. In addition, selected nonradioactive constituent concentrations in surface water discharged to unrestricted areas are determined. This report summarizes and discusses monitoring results for 1981.

The results of this environmental monitoring indicate that there are no significant sources of unnatural radioactive material in the vicinity of the ESG sites. Additionally, the similarity between on-site and off-site results further indicates that the contribution to general environmental radioactivity due to operations of ESG is essentially nonexistent.

The environmental radioactivity reported herein is attributed to natural sources and to fallout of radioactive material from foreign atmospheric testing of nuclear devices.

I. INTRODUCTION

The Energy Systems Group (ESG) of Rockwell International Corporation has been engaged in nuclear energy research and development since 1946. ESG is currently working on the design, development, fabrication, and testing of components and systems for central station power plants; on the fabrication of nuclear fuel for test and research reactors; and on the Decontamination and Disposition of Facilities (D&D) program. Other programs include the development and fabrication of systems for stack gas SO_2 control, production of gaseous and liquid fuels from coal, and solar energy development.

The administrative, scientific research, and manufacturing facilities (Figure 1) are located at the ESG De Soto site in Canoga Park, California, approximately 23 miles northwest of downtown Los Angeles. The site is level, typical of the San Fernando Valley floor. Certain nuclear programs, under licenses issued by the Nuclear Regulatory Commission (NRC) and the State of California, are conducted here. These include (1) Building 001 uranium fuel element fabrication facilities and (2) Building 004 analytical chemistry laboratories and gamma irradiation facility. The 290-acre ESG Santa Susana Field Laboratories (SSFL) site (Figure 2) is located in the Simi Hills of Ventura County, approximately 30 miles northwest of downtown Los Angeles. The SSFL site, situated in rugged terrain typical of mountain areas of recent geological age, is underlain by the Chico formation. The site may be described as an irregular plateau sprinkled with outcroppings above the more level patches and with peripheral eroded gullies. Elevations of the site vary from 1650 to 2250 ft above sea level. The surface mantle consists of sand and clay soil on sandstone. Both Department of Energy (DOE) and ESG owned facilities share this site, shown in Figure 3. SSFL also contains facilities in which nuclear operations licensed by NRC and the State are conducted. The licensed facilities include: (1) the Rockwell International Hot Laboratory (RIHL), Building 020; (2) the Nuclear Materials Development Facility (NMDF), Building 055; (3) a neutron radiography facility containing the L-85 nuclear examination and research reactor, Building 093; and (4) several X-ray and radioisotope radiography inspection facilities. The location of these sites in relation to nearby communities is shown in Figure 4.

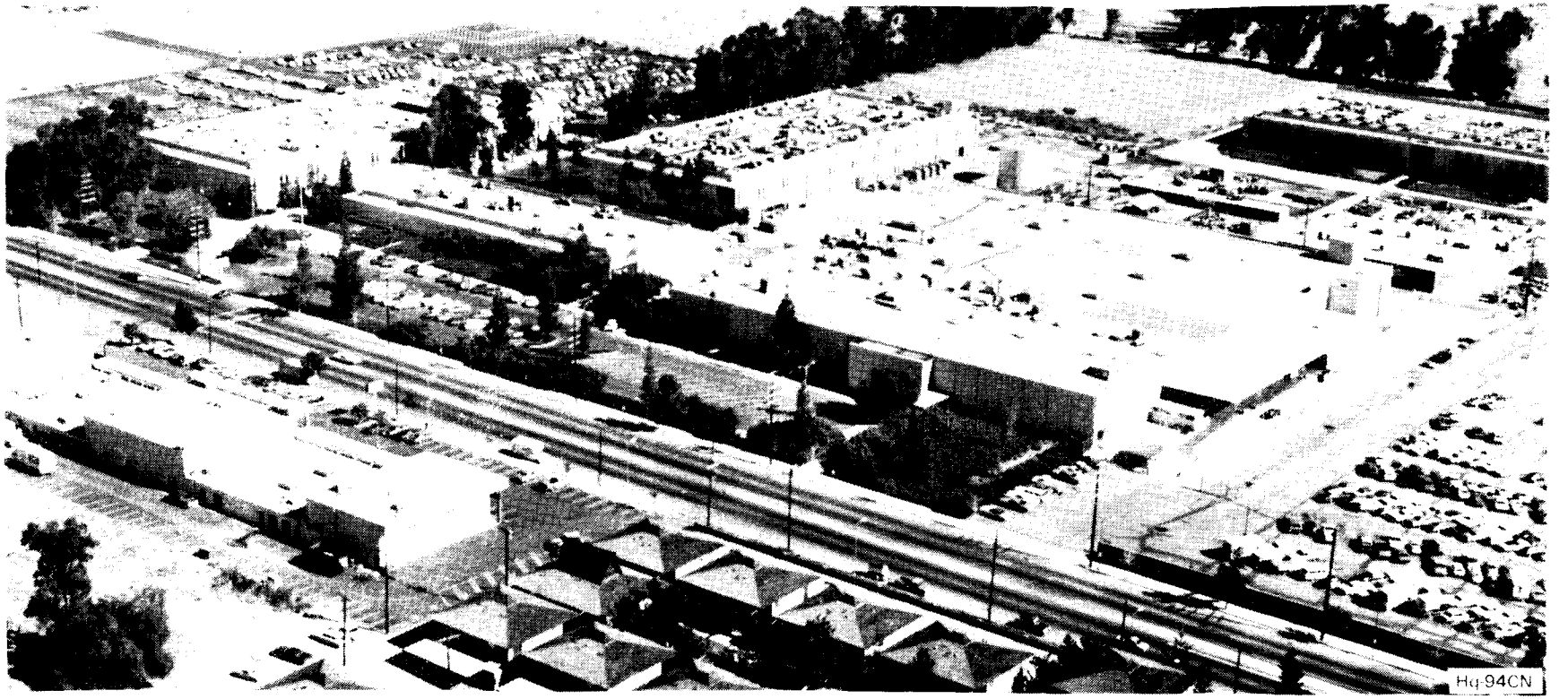

Figure 1. Energy Systems Group – De Soto Site

Figure 2. Energy Systems Group – Santa Susana Field Laboratories Site

Figure 3. Map of Santa Susana Field Laboratories Site Facilities

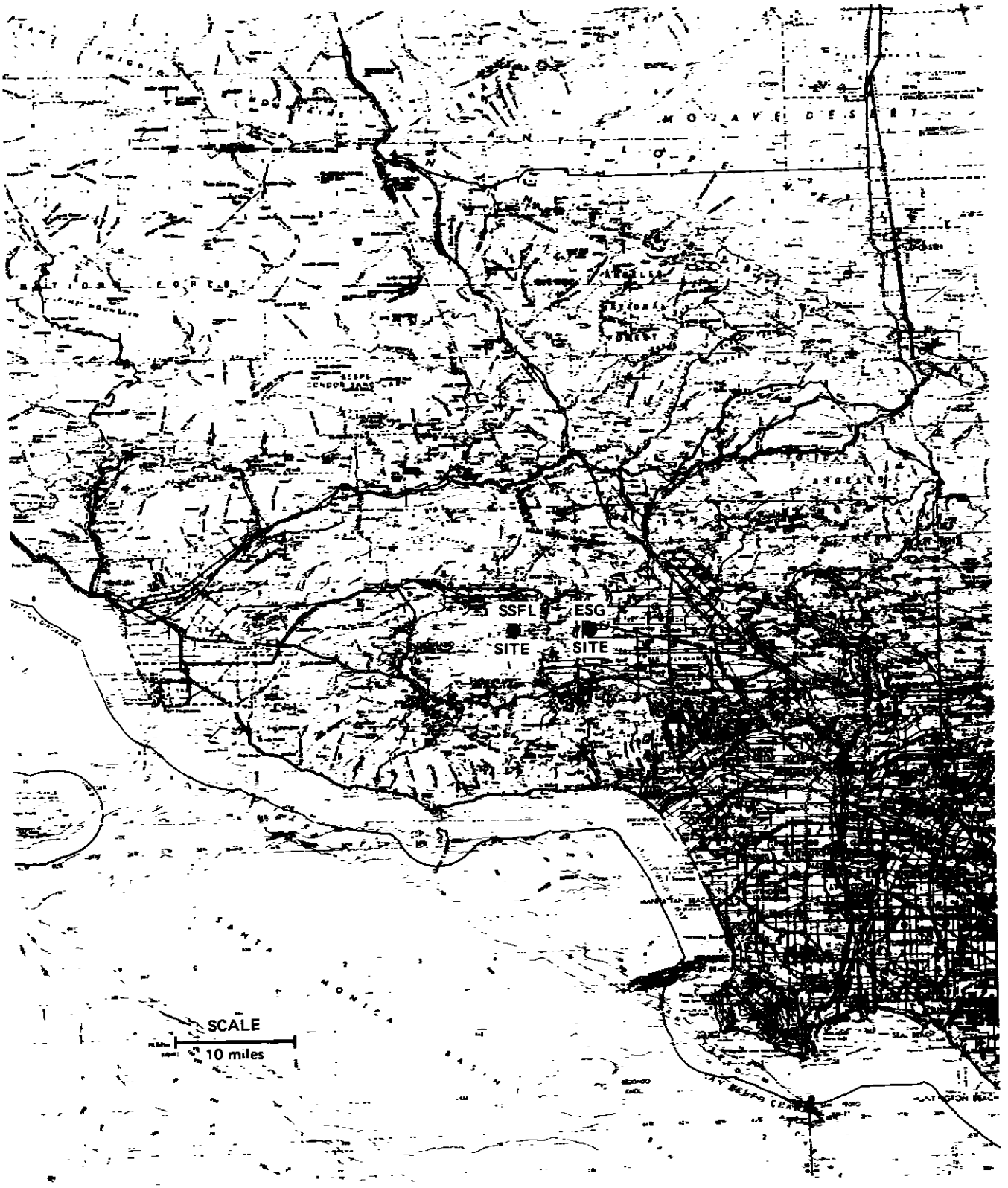

Figure 4. Map of General Los Angeles Area

Also included within the SSFL site is an 82-acre government-optioned area where DOE contract activities are conducted, primarily by the nonnuclear Energy Technology Engineering Center (ETEC). The major operational nuclear installation within the optioned area is the Radioactive Material Disposal Facility (RMDF), Buildings 021 and 022. This facility is used for packaging wastes generated as a result of the D&D program, begun in 1975. Several deactivated nuclear reactor and support facilities, all within the optioned area, are affected by the D&D program. Currently involved are several facilities that had been used for SNAP (Systems for Nuclear Auxiliary Power) reactor test operations, Buildings 024 and 059, and the Sodium Reactor Experiment (SRE), Building 143. No fissile material is located at any of these facilities.

Licensed programs conducted during 1981 included: (1) the operation of the RIHL for nuclear reactor fuel and system component examination and the fabrication of sealed radiation sources and (2) the operation of nuclear fuel manufacturing facilities for the production of experimental and test reactor fuel involving enriched uranium, and the development of processes for the fabrication of advanced fuels.

The basic policy for the control of radiological and chemical hazards at ESG requires that, through engineering controls, adequate containment of such materials be provided and that, through rigid operational controls, facility effluent releases and external radiation levels be reduced to a minimum. The environmental monitoring program provides a measure of the effectiveness of ESG's safety procedures and of the engineering safeguards incorporated into facility designs. Specific radionuclides in facility effluent or environmental samples are not routinely identified due to the extremely low radioactivity levels normally detected, but would be identified by analytical or radiochemistry techniques if significantly increased radioactivity levels were observed.

In addition to environmental monitoring, work area air and atmospheric emissions are continuously monitored or sampled, as appropriate. This provides a direct measure of the effectiveness of engineering controls and allows remedial action to be taken before a significant release of hazardous material can occur.

Environmental sampling stations located within the boundaries of ESG sites are referred to as "onsite" stations; those located within a 10-mile radius of a site are referred to as "offsite" stations. The De Soto and SSFL sites are sampled monthly to determine the concentration of radioactivity in typical surface soil, vegetation, and water. Soil is sampled onsite semiannually for plutonium analysis. Similar offsite environmental samples, except for plutonium analysis, are obtained quarterly. Continuous onsite and offsite ambient air sampling provides information concerning long-lived airborne particulate radioactivity. Onsite ambient radiation monitoring utilizing thermoluminescent dosimetry (TLD), begun in 1971, measures environmental radiation levels at the De Soto and SSFL sites and also at several offsite locations.

Nonradioactive wastes discharged to unrestricted areas are limited to liquids released to sanitary sewage systems and to surface water drainage systems. No intentional releases of any liquid pollutants are made to unrestricted areas. Liquid wastes generated at the De Soto site are discharged into the city sewage system. This effluent is sampled to determine radioactivity. Sanitary sewage from all DOE and ESG facilities at the SSFL site is treated at an on-site sewage plant. The plant outfall drains into retention pond R-2A, located on the adjoining Rocketdyne Division site. The surface water drainage system of SSFL is composed of catch ponds and open drainage ditches leading to retention pond R-2A. Water from the pond may be reclaimed as industrial process water, or released as necessary offsite into Bell Creek, a tributary of the Los Angeles River. The pond is monitored at discharge for radioactive and nonradioactive pollutants by Rocketdyne Division as required by discharge permits issued to Rocketdyne by the California Regional Water Quality Control Board.

This report summarizes environmental monitoring results for 1981. A comparison of 1981 radioactivity results with results from previous years appears in Appendix A.

II. ENVIRONMENTAL MONITORING SUMMARY RESULTS

A. RADIOACTIVE MATERIALS — 1981

The sampling and analytical methods used in the environmental monitoring program for radioactive materials are described in Section III.

The average radioactivity concentrations in local soil, vegetation, surface water, and ambient air for 1981 are presented in Tables 1 through 5. In calculating the averaged concentration value for Tables 1 through 4, all values, including negative ones, were averaged. The method of noncensored data averaging, recommended by DOE Order 5484.1, affords a better estimate of the central value and dispersion of the data. Only in Table 5 are sample values having radioactivity levels less than the minimum detection level (MDL) assumed to have a concentration value equal to the MDL. Thus, for measurements reported in Table 5 in which some apparent radioactivity concentrations are below the MDL, the true averaged value is actually somewhat less than the value reported.

The maximum level of radioactivity detected for a single sample is reported because of its significance in indicating the existence of a major episode or an area-wide location of radioactive material deposition. None of the maximum observed values, which, as the tables show, occurred randomly during the year, shows a great increase over the average values beyond natural variability. The ambient air sampling data show no greatly increasing or decreasing trends for most of the year and can be described as generally constant with some decrease in local airborne radioactivity levels occurring during the third and fourth quarters.

The results reported in Tables 1-A and 2 show no significant difference between onsite and offsite samples. Table 1-B shows no significant variation in soil plutonium concentrations for the 1981 sample sets. For comparison with the plutonium present as a result of nuclear weapons tests and satellite devices, published data from soil tests in nearby Burbank, California, in 1970-71 show a plutonium concentration of 10×10^{-9} μCi/g for Pu^{239} plus Pu^{240} and 0.3×10^{-9} μCi/g for Pu^{238}. The data in Table 1-B show no significant increases relative to

TABLE 1-A

SOIL RADIOACTIVITY DATA – 1981

Area	Activity	No. Samples	Gross Radioactivity (μCi/g)	
			Annual Average Value (Standard Deviation)	Maximum Observed Value[a] and Month Observed
Onsite (monthly)	α	144	$(0.69 \pm 0.20)\ 10^{-6}$	1.32×10^{-6} (December)
	β	144	$(25.4 \pm 3.5)\ 10^{-6}$	38.2×10^{-6} (May)
Offsite (quarterly)	α	48	$(0.64 \pm 0.23)\ 10^{-6}$	1.26×10^{-6} (July)
	β	48	$(22.8 \pm 4.5)\ 10^{-6}$	33.2×10^{-6} (April)

[a]Maximum value observed for single sample.

TABLE 1-B

SOIL PLUTONIUM RADIOACTIVITY DATA – 1981

Sample Location	8 July 1981 Survey Results		17 December 1981 Survey Results	
	Pu^{238} (μCi/g)	$Pu^{239} + Pu^{240}$ (μCi/g)	Pu^{238} (μCi/g)	$Pu^{239} + Pu^{240}$ (μCi/g)
S-56	$(-2.4 \pm 2.0)\ 10^{-9}$	$(2.0 \pm 2.4)\ 10^{-9}$	$(-2.9 \pm 2.1)\ 10^{-9}$	$(3.5 \pm 3.8)\ 10^{-9}$
S-57	$(-3.7 \pm 1.4)\ 10^{-9}$	$(0.04 \pm 1.7)\ 10^{-9}$	$(-3.4 \pm 1.5)\ 10^{-9}$	$(4.8 \pm 3.1)\ 10^{-9}$
S-58	$(-2.2 \pm 2.0)\ 10^{-9}$	$(4.2 \pm 2.7)\ 10^{-9}$	$(-3.6 \pm 0.8)\ 10^{-9}$	$(0.3 \pm 1.4)\ 10^{-9}$
S-59	$(-3.2 \pm 1.3)\ 10^{-9}$	$(4.5 \pm 2.7)\ 10^{-9}$	$(-3.4 \pm 0.7)\ 10^{-9}$	$(1.1 \pm 1.6)\ 10^{-9}$
S-60	$(-8.8 \pm 4.8)\ 10^{-9}$	$(15.9 \pm 5.5)\ 10^{-9}$	$(-2.5 \pm 1.5)\ 10^{-9}$	$(5.2 \pm 3.1)\ 10^{-9}$

Note: Minus (-) indicates sample value less than reagent blank.

the Burbank values. The detected activity is due to a variety of naturally occurring radionuclides, and to radioactive fallout resulting from the dispersal of nuclear weapons materials and fission products by atmospheric testing. No atmospheric tests in the northern hemisphere were announced during 1981. Naturally occurring radionuclides include Be^{7}, K^{40}, Rb^{87}, Sm^{147}, and the uranium and thorium series (including the inert gas radon and its radioactive daughters). Radioactivity from aged fallout consists primarily of the fission products Sr^{90}-Y^{90}, Cs^{137}, and Pm^{147}, and also U^{234} and Pu^{239}.

TABLE 2

VEGETATION RADIOACTIVITY DATA – 1981

Area	Activity	No. Samples	Gross Radioactivity (μCi/g)			% of Samples with Activity <MDL[b]
			Dry Weight Annual Average Value	Ash		
				Annual Average Value (Standard Deviation)	Maximum Value[a] and Month Observed	
Onsite (monthly)	α	144	$(0.03 \pm 0.04)\ 10^{-6}$	$(0.16 \pm 0.20)\ 10^{-6}$	1.23×10^{-6} (January)	51
	β	144	$(21.2 \pm 9.6)\ 10^{-5}$	$(137.0 \pm 52.0)\ 10^{-6}$	257.0×10^{-6} (July)	0
Offsite (quarterly)	α	48	$(0.04 \pm 0.07)\ 10^{-6}$	$(0.18 \pm 0.17)\ 10^{-6}$	0.52×10^{-6} (January)	44
	β	48	$(26.1 \pm 13.9)\ 10^{-5}$	$(129.0 \pm 58.0)\ 10^{-6}$	221.0×10^{-6} (April)	0

[a]Maximum value observed for single sample.
[b]Minimum detection level: 0.12×10^{-6} μCi/gα; 0.36×10^{-6} μCi/gβ (ash).

TABLE 3

SSFL SITE – DOMESTIC WATER RADIOACTIVITY DATA – 1981

Area	Activity	No. Samples	Gross Radioactivity (μCi/ml)	
			Average Value (Standard Deviation)	Maximum[a] Value and Month Observed
ESG-SSFL (monthly)	α	24	$(0.11 \pm 0.12)\ 10^{-9}$	0.44×10^{-9} (December)
	β	24	$(2.79 \pm 0.55)\ 10^{-9}$	3.65×10^{-9} (October)

[a]Maximum value observed for single sample.

TABLE 4

BELL CREEK AND ROCKETDYNE SITE RETENTION POND
RADIOACTIVITY DATA — 1981

Area (Monthly)	Activity	No. Samples	Gross Radioactivity Concentration			
			Average Value (Standard Deviation)	Maximum[a] Value and Month Observed	% of Guide[b]	% of Samples with Activity MDL[c]
Bell Creek mud no. 54 (μCi/g)	α	12	$(0.58 \pm 0.16)\ 10^{-6}$	0.77×10^{-6} (December)	NA	0
	β	12	$(23.5 \pm 2.1)\ 10^{-6}$	27.3×10^{-6} (November)	NA	0
Pond R-2A mud no. 55 (μCi/g)	α	12	$(0.79 \pm 0.23)\ 10^{-6}$	1.12×10^{-6} (December)	NA	0
	β	12	$(25.5 \pm 3.2)\ 10^{-6}$	32.9×10^{-6} (February)	NA	0
Bell Creek vegetation no. 54 (μCi/g-ash)	α	12	$(0.07 \pm 0.07)\ 10^{-6}$	0.25×10^{-6} (September)	NA	83
	β	12	$(103.0 \pm 45.1)\ 10^{-6}$	188.0×10^{-6} (May)	NA	0
Bell Creek vegetation no. 54 (μCi/g dry weight)	α	12	$(0.01 \pm 0.01)\ 10^{-6}$	0.05×10^{-6} (September)	NA	83
	β	12	$(16.0 \pm 6.44)\ 10^{-6}$	31.6×10^{-6} (October)	NA	0
Bell Creek water no. 16 (μCi/ml)	α	12	$(0.05 \pm 0.09)\ 10^{-9}$	0.20×10^{-9} (January)	<0.001	100
	β	12	$(3.78 \pm 0.65)\ 10^{-9}$	5.0×10^{-9} (October)	1.3	0
Pond water no. 6 (μCi/ml)	α	12	$(0.05 \pm 0.08)\ 10^{-9}$	0.17×10^{-9} (February)	<0.001	100
	β	12	$(4.25 \pm 0.63)\ 10^{-9}$	5.26×10^{-9} (December)	1.4	0
SSFL pond R-2A water no. 12 (μCi/ml)	α	12	$(0.07 \pm 0.15)\ 10^{-9}$	0.37×10^{-9} (January)	<0.001	83
	β	12	$(5.16 \pm 1.22)\ 10^{-9}$	8.30×10^{-9} (December)	1.7	0

[a] Maximum value observed for single sample
[b] Guide: 5×10^{-6} μCi/mlα, 3×10^{-7} μCi/mlβ; 10 CFR 20 Appendix B, CAC 17, DOE Order 5480.1
[c] Minimum detection level: 0.23×10^{-9} μCi/mlα; 0.64×10^{-9} μCi/mlβ.
NA — not applicable, no Guide value having been established

TABLE 5

AMBIENT AIR RADIOACTIVITY DATA - 1981

Site Location (Continuous)	Activity	No. Samples	Average Value (Standard Deviation)	Maximum[a] Value and Date Observed	% of Guide[b]	% of Samples with Activity < MDL
De Soto Onsite (μCi/ml)	α	704	$(<6.9 \pm 7.7)\ 10^{-15}$	2.5×10^{-14} (01/02)	<0.23	95[c]
	β		$(<1.2 \pm 0.2)\ 10^{-13}$	1.1×10^{-12} (03/01)	<0.04	10[d]
SSFL Onsite (μCi/ml)	α	1799	$(<6.8 \pm 7.9)\ 10^{-15}$	3.5×10^{-14} (11/18)	<11.3	96[c]
	β		$(<1.2 \pm 0.2)\ 10^{-13}$	1.1×10^{-12} (03/31)	<0.40	10[d]
SSFL sewage treatment plant Offsite (μCi/ml)	α	364	$(<6.9 \pm 7.4)\ 10^{-15}$	2.2×10^{-14} (01/24)	<11.5	94[c]
	β		$(<1.1 \pm 0.2)\ 10^{-13}$	5.5×10^{-13} (03/31)	<0.36	9[d]
SSFL Control Center Offsite (μCi/ml)	α	355	$(<6.8 \pm 7.0)\ 10^{-15}$	1.6×10^{-14} (02/23)	<11.3	96[c]
	β		$(<1.3 \pm 0.2)\ 10^{-13}$	1.6×10^{-12} (01/02)	<0.12	10[d]

[a] Maximum value observed for single sample

[b] Guide: De Soto site, 3×10^{-12} μCi/ml α, 3×10^{-10} μCi/ml β; 10 CFR 20 Appendix B, SSFL Site, 6×10^{-14} μCi/ml α, 3×10^{-11} μCi/ml β; 10 CFR 20 Appendix B, CAC 17 and DOE Order 5480.1

[c] MDL = 6.4×10^{-15} μCi/ml α—Individual daily samples with activity levels of 0 to 6.4×10^{-15} μCi/ml are recorded and averaged as 6.4×10^{-15} μCi/ml

[d] MDL = 1.3×10^{-14} μCi/ml β—Individual daily samples with activity levels of 0 to 1.3×10^{-14} μCi/ml are recorded and averaged as 1.3×10^{-14} μCi/ml. Indicated average values are upper limits, since some data were below the minimum detection levels.

Domestic water used at the SSFL site is obtained from Ventura County Water District No. 17, which also supplies nearby communities, and is distributed on the site by the same piping system previously used when all facility process water was obtained from onsite wells. Two onsite water wells were operated during 1981 to reduce the consumption of Ventura County domestic water. The well water proportion in the blend averaged about 43% for the year for a total well water consumption of about 4.6×10^7 gal. Pressure for the water system is provided by elevated storage tanks.

Water from the system is sampled monthly at two widely separated SSFL site locations. The average domestic water radioactivity concentration is presented in Table 3.

As discussed earlier, surface waters discharged from SSFL facilities and the sewage plant outfall drain southward into retention pond R-2A on Rocketdyne property. When full, the pond may be drained into Bell Creek, a tributary of the Los Angeles River in the San Fernando Valley, Los Angeles County. Pursuant to the requirements of Los Angeles Regional Water Quality Control Board Resolution 66-49 of 21 September 1966, a sampling station for evaluating environmental radioactivity in Bell Canyon was established in 1966. It is located approximately 2.5 miles downstream from the southern Rockwell International Corporation boundary. Samples, obtained and analyzed monthly, include stream bed mud, vegetation, and water. Average radioactivity concentrations in Rocketdyne and Bell Creek samples are presented in Table 4.

Comparison of the radioactivity concentrations in water from the ponds and from Bell Creek with that of the domestic water supply shows no significant variation in either alpha or beta activity.

The SSFL site surface water and the ambient air radioactivity concentration guide values selected for each site are the most restrictive limits for those radionuclides currently in use at ESG facilities. Radioactivity concentration guide values are those concentration limits adopted by DOE, NRC, and the State of California as maximum permissible concentrations (MPCs). The MPC values are dependent on the radionuclide and its behavior as a soluble or an insoluble material. For comparison with results of environmental and effluent monitoring, the lowest MPC value for the various radionuclides present is selected. Accordingly, for SSFL site surface water, the guide values of 5×10^{-6} µCi/ml alpha activity corresponding to Pu^{239} and 3×10^{-7} µCi/ml beta activity corresponding to Sr^{90} are appropriate. The corresponding most restrictive guide value for De Soto site wastewater radioactivity discharged to the sanitary sewage system,

a controlled area, is 9 x 10^{-4} μCi/ml alpha activity corresponding to U^{234} and 1 x 10^{-3} μCi/ml beta activity corresponding to Co^{60}. These values are established in 10 CFR 20, California Administrative Code Title 17, and DOE Order 5480.1.

The guide value of 6 x 10^{-14} μCi/ml for SSFL site ambient air alpha activity is due to work with unencapsulated plutonium. The value of 3 x 10^{-11} μCi/ml for beta activity is due to the presence of Sr^{90} in fission products in irradiated nuclear fuel at the SSFL site. The guide value of 3 x 10^{-12} μCi/ml for De Soto ambient air alpha activity is due to work with unencapsulated uranium (including depleted uranium). The guide value of 3 x 10^{-10} μCi/ml is for Co^{60}, for which the ambient air beta activity guide is appropriate since it is the most restrictive limit for beta-emitting radionuclides present at the De Soto site. Guide value percentages are not presented for soil or vegetation data since none have been established.

Ambient air sampling for long-lived particulate alpha and beta radioactivity is performed continuously by automatic sequential samplers located at both the De Soto and SSFL sites. Air is drawn through Type HV-70 filter media, which are analyzed for long-lived radioactivity after a minimum 120-h decay period that eliminates naturally occurring short-lived particulate radioactivity. The average concentrations of ambient air alpha and beta radioactivity for 1981 are presented for the various locations in Table 5.

Radioactivity levels observed in environmental samples for 1981, reported in Tables 1 through 5, compare closely with levels reported for recent years. Local environmental radioactivity levels, which result primarily from beta-emitting radionuclides and which had shown the effect of fallout during past extensive atmospheric testing of nuclear devices, have decreased and have been generally constant during the past several years. The effects of foreign atmospheric nuclear tests continue to be occasionally observed in daily ambient airborne radioactivity levels. The long-term effects of airborne radioactivity on surface sample radioactivity levels are not discernible for recent years. The

continuing relative constancy in environmental radioactivity levels is due primarily to the dominance of naturally occurring radionuclides in the environment and to the longer-life fission product radioactivity from aged fallout.

Site ambient radiation monitoring is performed with thermoluminescent dosimeters. Each dosimeter contains two calcium fluoride (CaF_2:Mn) low background, bulb-type chip dosimeters. The dosimeter sets are placed at locations on or near the perimeters of the De Soto and SSFL sites. Each dosimeter, sealed in a light-proof energy compensation shield, is installed in a polyethylene container which is mounted about 1 m above ground at each location. The dosimeters are exchanged and evaluated quarterly. Thirteen on-site TLD monitoring locations were used during the year. Five additional dosimeter sets, placed at locations up to 10 miles from the ESG sites, are similarly evaluated to determine the local area offsite ambient radiation level, which averaged 17 μR/h for 1981. The quarterly and annual radiation exposures and the equivalent annual exposure rates monitored at each dosimeter location are presented in Table 6.

The table shows that radiation exposures and equivalent annual exposure rates monitored onsite are nearly identical to levels monitored at five widely separated offsite locations. These data include natural background radiation from cosmic radiation, radionuclides in the soil, radon and thoron in the atmosphere, and radioactive fallout from nuclear weapons tests. Locally, the natural background radiation level is about 150 mR/year. The small variability observed in the data is attributed to differences in elevation and geologic conditions at the various dosimeter locations. Since the data for the onsite and offsite locations are nearly identical, no measurable radiation dose to the general population or to individuals in uncontrolled areas resulted from ESG operations.

During the four-year period 1977 through 1980, a steady increase was observed in the TLD readings for all locations. Although the increases were variable from year to year and between locations, averaged over four years, the increases were in the range of 14 to 17 mR per year. The values for 1981 show a slight, but not statistically significant, decrease. Among DOE-contractor environmental monitoring

TABLE 6

DE SOTO AND SSFL SITES — AMBIENT RADIATION
DOSIMETRY DATA — 1981

TLD Location	Quarterly Exposure (mR)				Annual Exposure (mR)	Equivalent Exposure Rate (μR/h)
	Q-1	Q-2	Q-3	Q-4		
1. De Soto	35	32	32	40	140	16
2. De Soto	36	35	32	41	144	16
3. De Soto	33	29	31	47	140	16
4. De Soto	36	36	44	43	159	18
5. De Soto	36	29	32	39	136	15
6. De Soto	40	33	33	48	154	17
7. De Soto	35	31	31	38	135	15
Mean value					144 ± 9	16.1
1. SSFL	39	37	35	48	159	18
2. SSFL	43	33	36	54	166	19
3. SSFL	44	40	46	58	188	21
4. SSFL	(44)[a]	40	39	50	173	20
5. SSFL	39	31	36	44	150	17
6. SSFL	37	31	30	39	137	16
Mean value					162 ± 18	18.5
1. Offsite control	38	32	36	32	138	16
2. Offsite control	39	33	35	55	162	18
3. Offsite control	35	31	33	33	132	15
4. Offsite control	44	34	37	37	152	17
5. Offsite control	40	36	35	45	156	18
Mean value					148 ± 13	16.8

[a]Missing dosimeter, assumed value

Note: The elevation for the De Soto and offsite dosimeters is about 1000 ft less than those for the SSFL site. From sea level to a few thousand feet in elevation, the increase in annual exposure is approximately 15 mR/1000 ft. This amount subtracted from the SSFL site results would provide good agreement between the three data sets.

programs, this apparent increase in radiation readings was observed by only one other contractor; that contractor is also the only other contractor using the CaF_2:Mn bulb-type dosimeters that are used at ESG.

Thus, the effect appears to be related to this particular type of dosimeter. A study of this problem is continuing. Supplementary measurements of the ambient radiation are being made with a high-pressure ion chamber (HPIC) at each site. The old TLD reader has been replaced with a new, more accurate and precise reader. Before being used, the dosimeters are being screened for internal radioactive contamination to eliminate self-dosing TLDs and are being stored in a lead shield. Also, the specific identity of each dosimeter bulb is being maintained in order to evaluate their long-term performance on an individual basis.

Use of the new reader for the first quarter of 1982 indicates an annualized total dose equivalent to about 128 mRem. The HPIC values are approximately 10% lower than the TLD values for each monitoring method. State of California TLDs (LiF) placed at the same locations with each of five ESG dosimeters at both onsite and offsite areas show an annual average dose for 1981 of 128 mR for all locations.

B. NONRADIOACTIVE MATERIALS — 1981

Processed wastewater and most collected surface runoff discharged from the SSFL site flows to retention pond R-2A, operated by Rocketdyne. Water samples from the pond are analyzed for various constituents, as required by the Regional Water Quality Control Board, for each discharge to Bell Canyon. Such discharges are normally required only as a result of excessive rainfall run-off. During such releases, the NPDES permit concentration limits for turbidity and for suspended and settleable solids do not apply. The results of analyses for each discharge for 1981, most of which were rainfall-related discharges, are presented in Table 7.

TABLE 7

NONRADIOACTIVE CONSTITUENTS IN WASTEWATER DISCHARGED TO UNRESTRICTED AREAS - 1981
(Analysis Results for Wastewater Discharged from Pond R-2A to Bell Creek on Date Indicated - Sample Station W-12)

Constituents	January 28[d]		February 9[a]		February 26[a]		March 2[a]		March 20[d]		April 20[a]		September 16[a]		November 28[a]	
	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide	Result	% of Guide
Total dissolved solids (mg/l)	320	33.7	424	44.6	513	54.0	271	28.5	441	46.4	455	47.9	681	71.7	221	23.3
Chloride (mg/l)	38	25.3	56	37.3	62	41.3	32	21.3	44	29.3	57	38.0	81	54.0	22	14.7
Sulfate (mg/l)	65	21.7	96	32.0	108	36.0	63	21.0	187	62.3	99	33.0	181	60.3	52	17.3
Suspended solids[b] (mg/l)	80	53.3	44	29.3	31	20.7	67	44.7	72	48.0	13	8.7	12	8.0	62	41.3
Settleable solids[b] (mg/l)	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	<0.1	<33.3	0.1	33.3	<0.1	<33.3	<0.1	<33.3
BOD_5 (mg/l)	8	13.3	6	10.0	9	15.0	6	10.0	17	28.3	5	8.3	5	8.3	11	18.3
Oil and grease (mg/l)	<1	<6.7	3	20.0	1	6.7	1	6.7	<1	<6.7	<1	<6.7	<1	<6.7	3	20.0
Turbidity (TU)	53	-	31		26	-	50	-	52	-	10	-	6	-	41	-
Chromium (mg/l)	0.014	140.0	0.008	80.0	0.006	60.0	0.011	110.0	0.018	180	0.004	40.0	0.001	10.0	0.004	40.0
Fluoride (mg/l)	0.6	60.0	0.7	70.0	0.7	70.0	0.5	50.0	0.4	40.0	0.5	50.0	0.5	50.0	0.5	50.0
Boron (mg/l)	<0.2	<20.0	0.3	30.0	0.2	20.0	<0.2	<20.0	0.2	20.0	0.3	30.0	0.3	30.0	<0.2	<20.0
Residual chlorine (mg/l)	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0	<0.04	<40.0
Fecal coliform (MPN/100 ml)	<2	<8.7	<2	<8.7	<2	<8.7	<2	<8.7	<2	<8.7	<2	<8.7	<2	<8.7	<2	<8.7
Surfactants (MBAS)	0.04	8.0	0.07	14.0	0.02	4.0	0.02	4.0	0.04	8.0	0.4	80.0	0.04	8.0	<0.01	<2.0
pH	7.8		8.7		8.6		7.8		7.8		7.8		8.4		7.6	
Rainfall (in.)	2.75		1.0		2.7		4.27		0.97		0.55		0		2.31	
Est. rainfall runoff (gal)	5.2×10^7		2.0×10^7		5.3×10^7		8.4×10^7		1.9×10^7		1.1×10^7		0		4.6×10^7	
Release volume (gal)	2.0×10^6		1.7×10^6		1.3×10^6		3.0×10^5		2.5×10^6		2.3×10^6		1.1×10^6		2.5×10^6	

[d] Rainfall related discharge.
[b] Not applicable to discharges containing rainfall runoff during or immediately after periods of rainfall.
Note: Pond R-2A capacity 2.5×10^6 gal.

III. ENVIRONMENTAL MONITORING PROGRAM

A. GENERAL DESCRIPTION

Soil and vegetation sample collection and analysis for radioactivity were initiated in 1952, in the Downey, California area, where the Energy Systems Group was initially located. Environmental sampling was subsequently extended to the then proposed SRE site in the Simi Hills in May of 1954. In addition, sampling was begun in the Burro Flats area, southwest of SRE, where other nuclear installations were planned and are currently in operation. The Downey area survey was terminated when nuclear activities were relocated to Canoga Park in 1955. The primary purpose of the environmental monitoring program is to survey environmental radioactivity adequately to ensure that ESG operations do not contribute significantly to environmental radioactivity. The locations of sampling stations are shown in Figures 5 through 7 and listed in Table 8.

B. SAMPLING AND SAMPLE PREPARATION

1. Soil

Soil is analyzed for radioactivity to monitor for any significant increase in radioactive deposition by fallout from airborne radioactivity. Since soil is naturally radioactive and has been contaminated by atmospheric testing of nuclear weapons, a general background level of radioactivity exists. The data are monitored for increases beyond the natural variability of this background.

Surface soil types available for sampling range from decomposed granite to clay and loam. Samples are taken from the top 1-cm layer of undisturbed ground surface for gross radioactivity analysis and to a depth of 5 cm for plutonium analysis. The soil samples are packaged in plastic containers and returned to the laboratory for analysis.

Sample preparation for gross radioactivity determination consists of transferring the soils to Pyrex beakers and drying in a muffle furnace at about 500°C

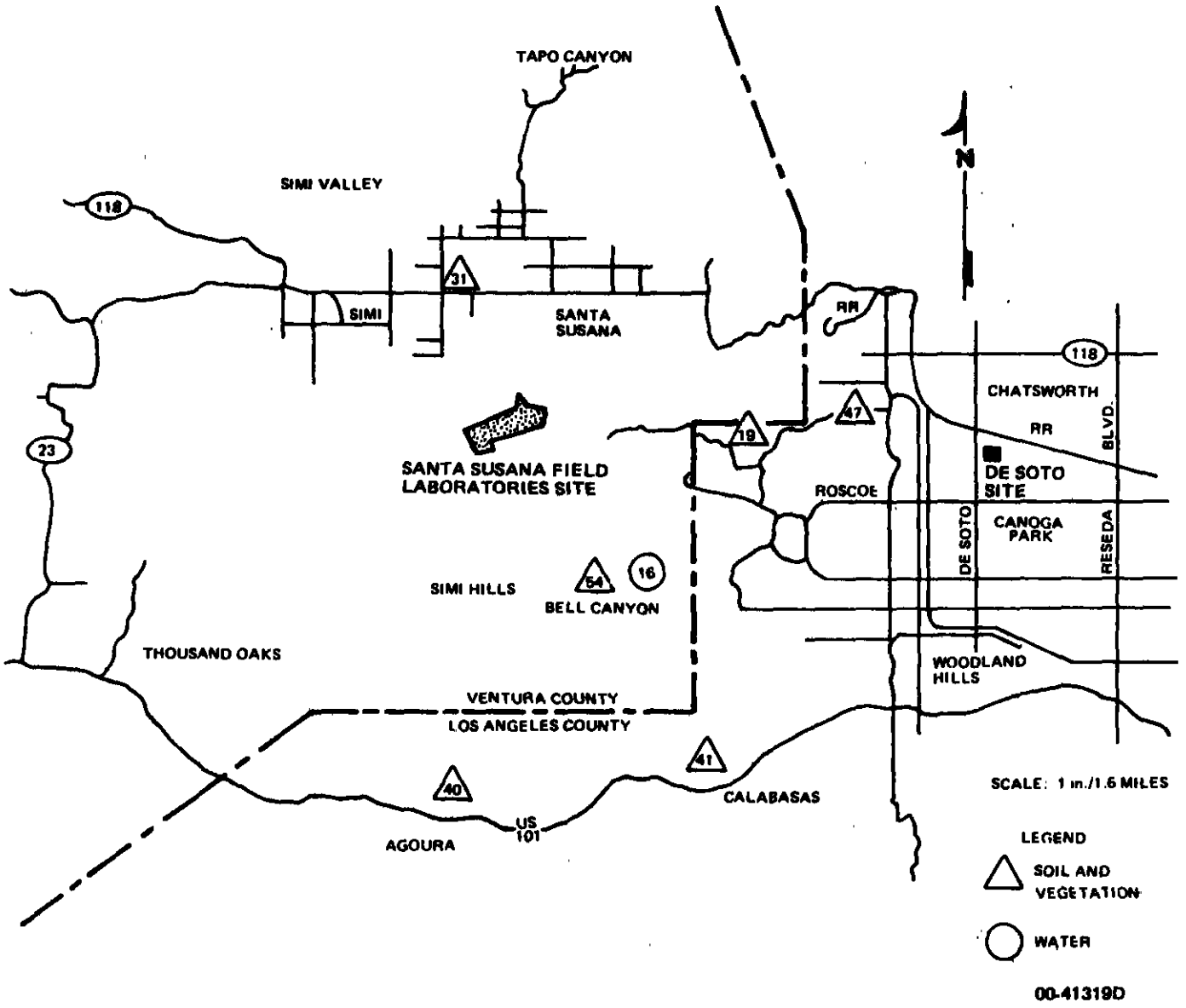

Figure 5. Map of Canoga Park, Simi Valley, Agoura, and Calabasas Sampling Stations

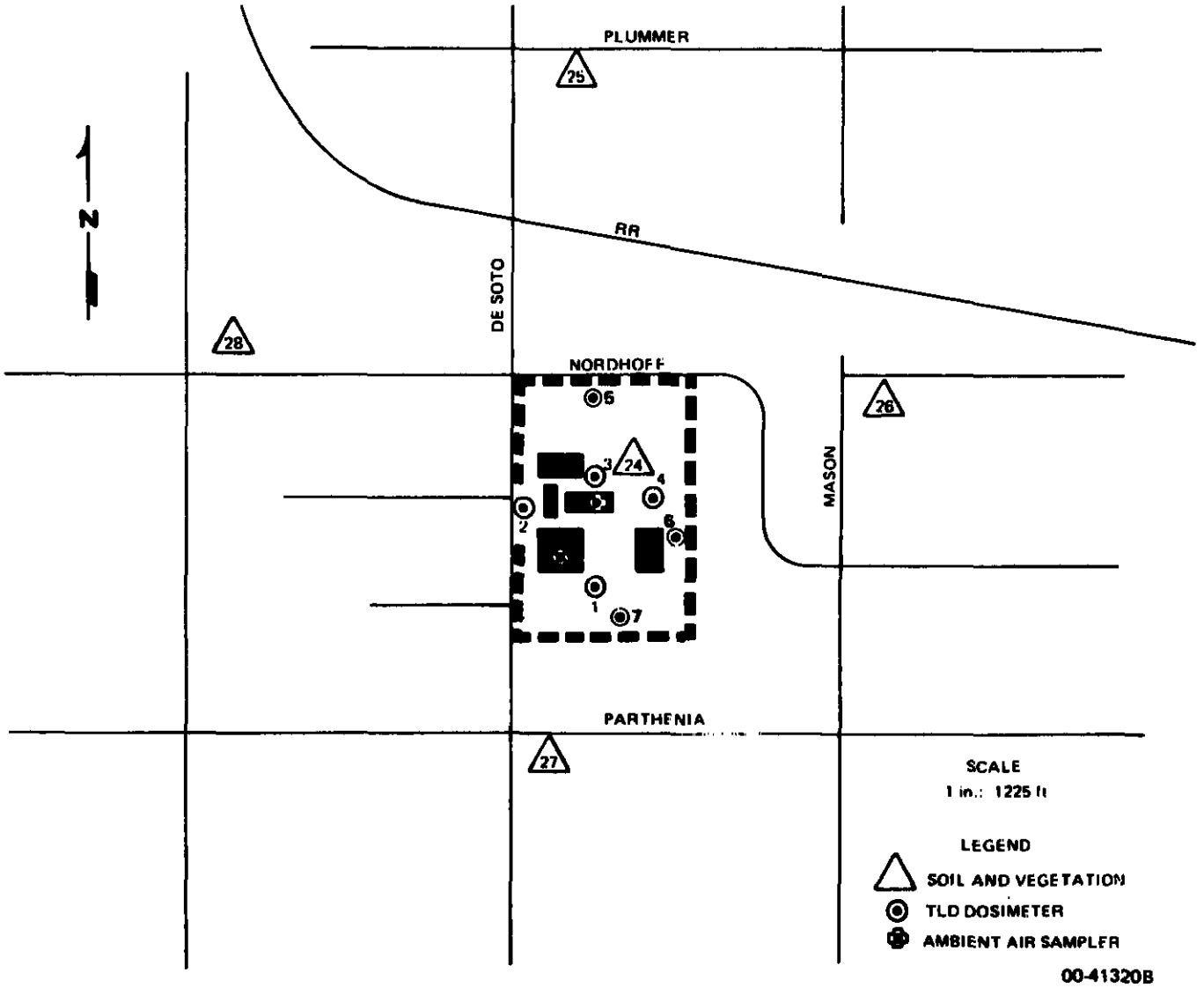

Figure 6. Map of De Soto Site and Vicinity Sampling Stations

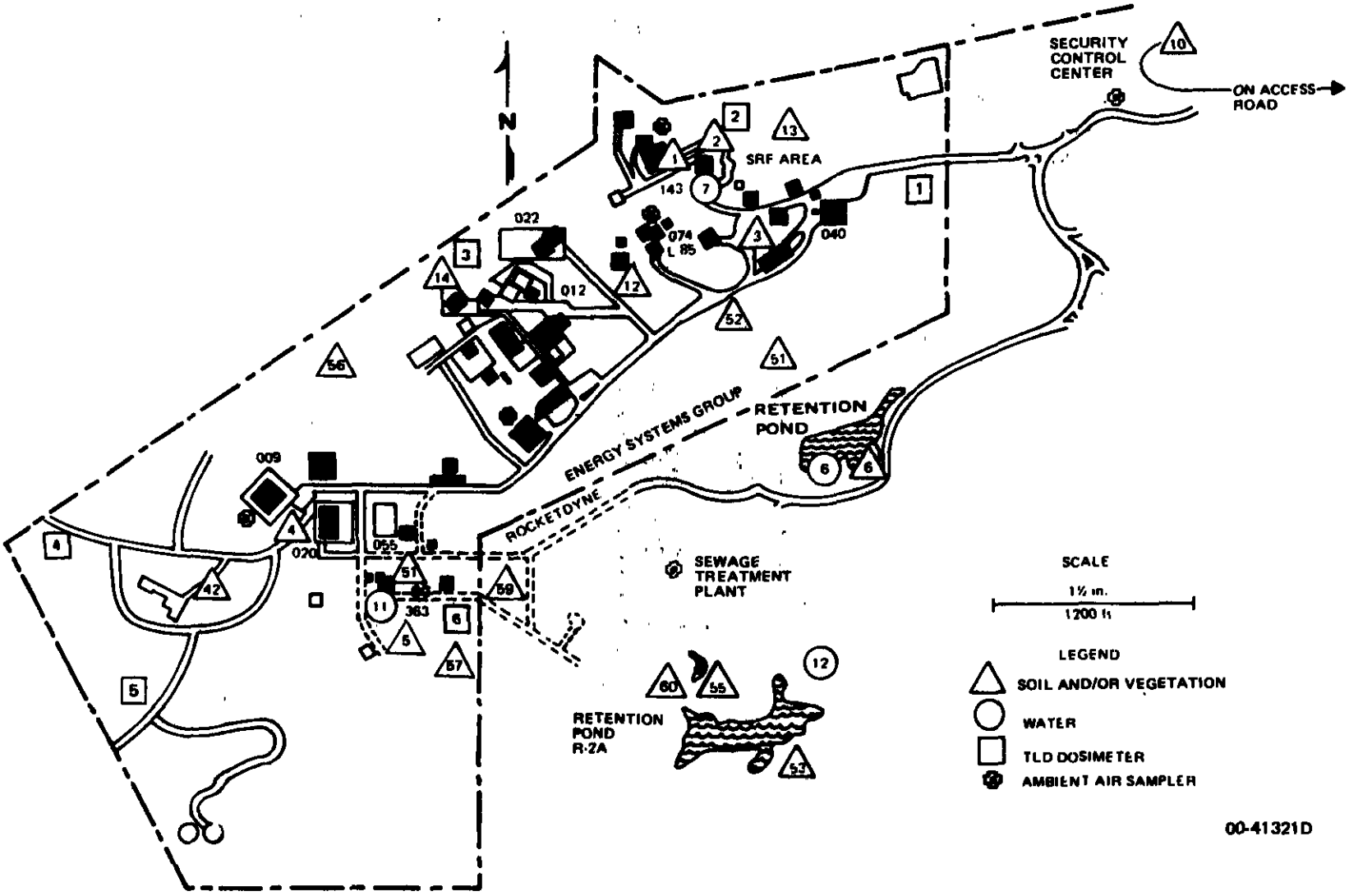

Figure 7. Map of Santa Susana Field Laboratories Site Sampling Stations

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 1 of 3)

Station	Location (frequency of sampling)
SV-1	SSFL Site, Bldg. 143 (M)
SV-2	SSFL Site, Bldg. 143 Perimeter Drainage System (M)
SV-3	SSFL Site, Bldg. 064 (M)
SV-4	SSFL Site, Bldg. 020 (M)
SV-5	SSFL Site, Bldg. 363 (M)
SV-6	Rocketdyne Site Interim Retention Pond (Q)
SV-10	SSFL Site Access Road (Q)
SV-12	SSFL Site, Bldg. 093 (L-85 Reactor) (M)
SV-13	SSFL Site, at SRE Water Retention Pond (M)
SV-14	SSFL Site, Bldg. 028 (M)
SV-19	SSFL Site Entrance, Woolsey Canyon (Q)
SV-24	De Soto Site, Bldg. 004 (M)
SV-25	De Soto Avenue and Plummer Street (Q)
SV-26	Mason Avenue and Nordhoff Street (Q)
SV-27	De Soto Avenue and Parthenia Street (Q)
SV-28	Canoga Avenue and Nordhoff Street (Q)
SV-31	Simi Valley, Alamo Avenue and Sycamore Road (Q)
SV-40	Agoura – Kanan Road and Ventura Freeway (Q)
SV-41	Calabasas – Parkway Calabasas and Ventura Freeway (Q)
SV-42	SSFL Site, Bldg. 886 (M)
SV-47	Chatsworth Reservoir North Boundary (Q)
SV-51	SSFL Site, Bldg. 029 (M)
SV-52	SSFL Site, Burro Flats Drainage Control Pond, G Street and 17th Street (M)
SV-53	Rocketdyne Site Pond R-2A Spillway, Head of Bell Canyon (Q)

SV – Soil and Vegetation Sample Station
M – Monthly Sample
Q – Quarterly Sample

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 2 of 3)

Station	Location (frequency of sampling)
SV-54	Bell Creek (M)
S-55	Rocketdyne Site Retention Pond R-2A (Pond Bottom Mud) (M)
S-56	SSFL Site, F Street and 24th Street (S)
S-57	SSFL Site, J Street at Bldg. 055 (S)
S-58	SSFL Site, Bldg. 353 (S)
S-59	Rocketdyne Site Test Area CTL 4 (S)
S-60	Rocketdyne Site Retention Pond R-2A (S)
W-6	Rocketdyne Site Interim Retention Pond (drains to Pond R-2A) (M)
W-7	SSFL Site Domestic Water, Bldg. 003 (M)
W-11	SSFL Site Domestic Water, Bldg. 363 (M)
W-12	Rocketdyne Site Area II Final Retention Pond R-2A (M)
W-16	Bell Creek (M)
A-1	De Soto Site, Bldg. 001 Roof (D)
A-2	De Soto Site, Bldg. 004 Roof (D)
A-3	SSFL Site, Bldg. 009, West Side (D)
A-4	SSFL Site, Bldg. 011, West Side (D)
A-5	Rocketdyne Site, Bldg. 600, North Side (D)
A-6	Rocketdyne Site, Bldg. 207, North Side (D)
A-7	SSFL Site, Bldg. 074, South Side (D)
A-8	SSFL Site, Bldg. 143, West Side (D)
A-9	SSFL Site, Bldg. 363, West Side (D)
TLD-1	De Soto Site, South of Bldg. 102 (Q)
TLD-2	De Soto Site, West Boundary (Q) (State of California TLD Location)
TLD-3	De Soto Site, Guard Post No. 1, Bldg. 201 (Q)

S — Soil Sample Station
W — Water Sample Station
A — Air Sampler Station
TLD — Thermoluminescent Dosimeter Location
D — Daily Sample
M — Monthly Sample
Q — Quarterly Sample
S — Semiannual Sample

TABLE 8

SAMPLE STATION LOCATIONS
(Sheet 3 of 3)

Station	Location (frequency of sampling)
TLD-4	De Soto Site, East Fence (Q) (State of California TLD Location)
TLD-5	De Soto Site, North Boundary (Q)
TLD-6	De Soto Site, East Boundary (Q)
TLD-7	De Soto Site, South Boundary (Q)
TLD-1	SSFL Site, Bldg. 114 (Q)
TLD-2	SSFL Site, SRE Retention Pond (Q)
TLD-3	SSFL Site, Electric Substation No. 719 (Q) (State of California TLD Location)
TLD-4	SSFL Site, West Boundary on H Street (Q)
TLD-5	SSFL Site, at Southwest Boundary (Q)
TLD-6	SSFL Site, Bldg. 854 (Q) (State of California TLD Location)
TLD-1	Offsite, Northridge (Q)
TLD-2	Offsite, Simi Valley (Q)
TLD-3	Offsite, Northridge (Q) (State of California TLD Location)
TLD-4	Offsite, Simi Valley (Q)
TLD-5	Offsite, Simi Valley (Q)

TLD — Thermoluminescent Dosimeter Location
Q — Quarterly Sample

for 8 h. After cooling, the soil is sieved to obtain uniform particle size. Two-gram aliquots of the sieved soil are weighed into copper planchets. The soil is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, dried, and counted for alpha and beta radiation. Soil plutonium analysis is performed (according to the guidelines specified in U.S. NRC Regulatory Guide 4.5 titled "Measurements of Radionuclides in the Environment-Sampling and Analysis of Plutonium in Soil") by a certified independent testing laboratory.

2. Vegetation

The analysis of vegetation, performed as an adjunct to the soil analysis, is done to determine the uptake of radioactivity by plants. These plants do not contribute to the human food chain, and there is no significant agriculture or grazing in the immediate neighborhood of either site.

Vegetation samples obtained in the field are of the same perennial plant types, wherever possible; these are usually sunflower or wild tobacco. Vegetation leaves are stripped from plants and placed in ice cream cartons for transfer to the laboratory for analysis. Ordinarily, plant root systems are not analyzed.

Since the analysis is done to determine uptake only, and not fallout deposition, vegetation is first washed with tap water to remove foreign matter and then thoroughly rinsed with distilled water. Washed vegetation is vacuum dried in tared beakers at 100°C for 24 h for dry weight determination, then ashed in a muffle furnace at about 500°C for 8 h, producing a completely burned ash. One-gram aliquots of pulverized ash from each beaker are weighed into copper planchets. The vegetation ash is wetted in the planchet with alcohol, evenly distributed to obtain uniform sample thickness, dried, and counted for alpha and beta radiation. The dry/ash weight ratio is used for determining the equivalent dry weight gross radioactivity concentration value. The moisture content of the vegetation is about 80% of total plant weight.

3. Water

Surface and domestic supply water samples are obtained monthly at the SSFL site and from Bell Creek. The water is drawn into 1-liter polyethylene bottles and transferred to the laboratory.

Five-hundred-milliliter volumes of water are evaporated to dryness in crystallizing dishes at about 90^{0}C. The residual salts are redissolved into distilled water, transferred to planchets, dried under heat lamps, and counted for alpha and beta radiation.

4. Ambient Air

Air sampling is performed continuously at the De Soto and SSFL sites with automatic air samplers, operating on 24-h sampling cycles. Airborne particulate radioactivity is collected on Type HV-70 filter media, which are automatically changed daily at the end of each sampling period. The samples are counted for alpha and beta radiation following a minimum 120-h decay period. The volume of a typical daily ambient air sample is about 25 m^3.

Figure 8 is a graph of the daily averaged long-lived alpha and beta ambient air radioactivity concentrations for the De Soto and SSFL sites during 1981. The average beta concentration for each month is also indicated by horizontal bars. The graph shows a generally decreasing trend in airborne radioactivity during the final two quarters of the year. Several transient peak concentration levels were observed within the general trend. This activity is attributed to residual fallout from past foreign atmospheric tests of nuclear devices.

C. COUNTING AND CALIBRATION

Environmental soil, vegetation, water, and ambient air samples are counted for alpha and beta radiation with a low-background gas flow proportional counting system. The system is capable of simultaneously counting both alpha and net beta radiation. The sample-detector configuration provides a nearly 2π geometry. The

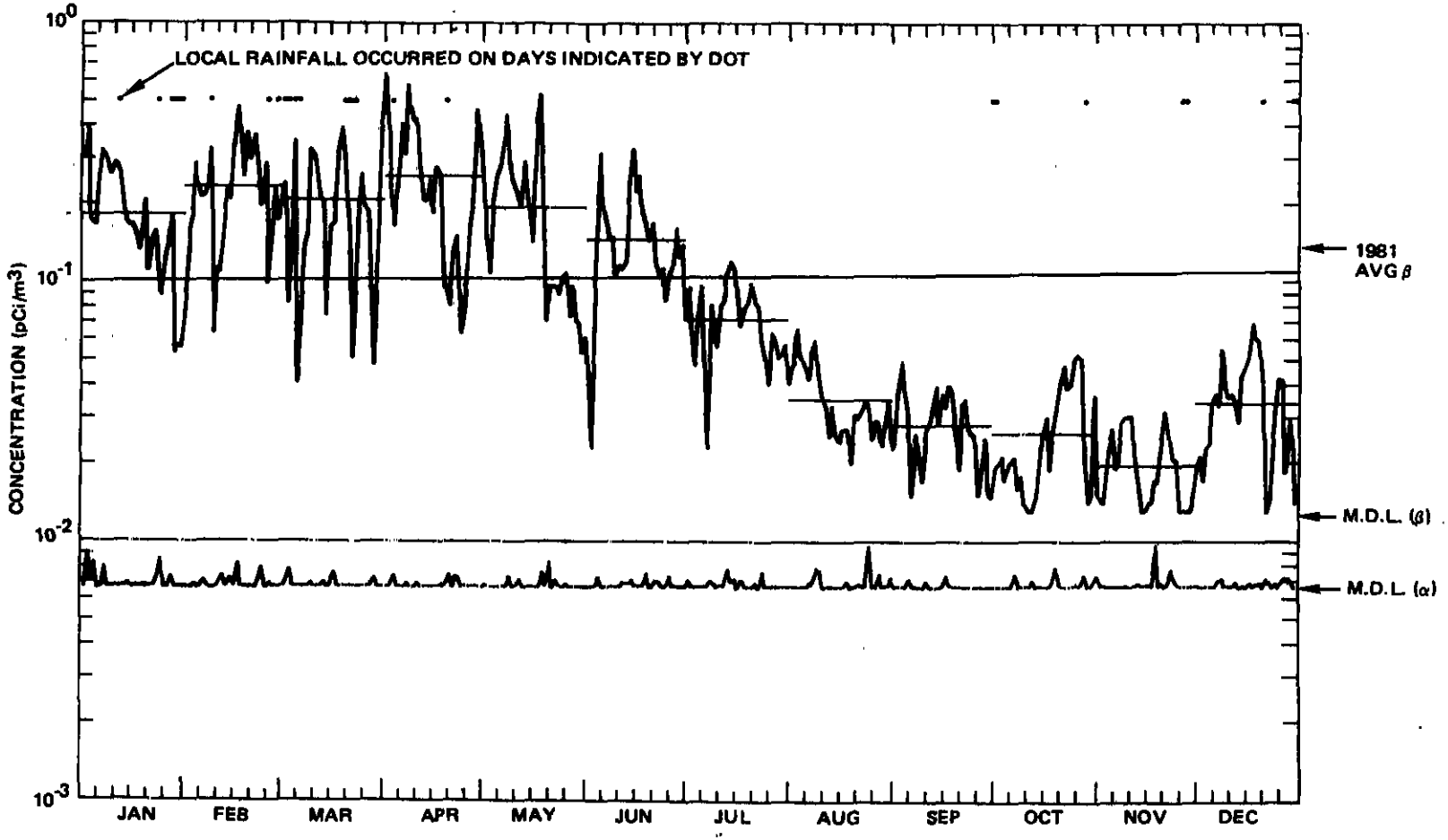

Figure 8. Daily Averaged Long-Lived Airborne Radioactivity at the De Soto and Santa Susana Field Laboratories Sites – 1981

thin-window detector is continually purged with methane counting gas. A preset time mode of operation is used for all samples. The minimum detection levels shown in Table 9 were determined by using typical values for counting time, system efficiencies for detecting alpha and beta radiation, background countrates (approximately 0.05 cpm α and 1.0 cpm β), and sample size. For the table, the minimum statistically significant amount of radioactivity, irrespective of sample configuration, is taken as that amount equal in count rate to three times the standard deviation of the system background count rate.

TABLE 9

MINIMUM RADIOACTIVITY DETECTION LEVELS (MDLs)

Sample	Activity	Minimum Detection Level
Soil	α	$(5.8 \pm 6.9)\ 10^{-8}$ µCi/g
	β	$(2.3 \pm 2.3)\ 10^{-7}$ µCi/g
Vegetation	α	$(1.2 \pm 1.4)\ 10^{-7}$ µCi/g ash
	β	$(3.6 \pm 3.6)\ 10^{-7}$ µCi/g ash
Water	α	$(2.3 \pm 2.7)\ 10^{-10}$ µCi/ml
	β	$(6.4 \pm 6.3)\ 10^{-10}$ µCi/ml
Air	α	$(6.4 \pm 7.6)\ 10^{-15}$ µCi/ml
	β	$(1.3 \pm 1.2)\ 10^{-14}$ µCi/ml

Counting system efficiencies are determined routinely with Ra-D+E+F (with alpha absorber), Cl^{36}, Th^{230}, U^{235}, and Pu^{239} standard sources and with K^{40}, in the form of standard reagent grade KCl, which is used to simulate soil and vegetation samples. Self-absorption standards are made by dividing sieved KCl into samples, increasing in mass by 200-mg increments, from 100 to 3000 mg. The samples are placed in copper planchets, of the type used for environmental samples, and counted. The ratio of sample activity to the observed net count rate for each sample is plotted as a function of sample weight. The correction factor (ratio) corresponding to sample weight is obtained from the graph. The

product of the correction factor and the net sample count rate yields the sample activity (dpm). This method has been proven usable by applying it to various-sized aliquots of uniformly mixed environmental samples and observing that the resultant specific activities fell within the expected statistial counting error.

Since the observed radioactivity in environmental samples results primarily from natural and weapons-testing sources, and is at such low concentrations, no effort is made to identify individual radionuclides. The detection of significant levels of radioactivity would lead to an investigation of the radioactive material involved, the sources, and the possible causes.

D. NONRADIOACTIVE MATERIALS

Rockwell International Corporation, Rocketdyne Division, has filed a Report of Waste Discharge with the California Regional Water Quality Control Board and has been granted a National Pollutant Discharge Elimination System permit to discharge wastewater, pursuant to Section 402 of the Federal Water Pollution Control Act. The permit, NPDES No. CA0001309, became effective on 27 September 1976 and supersedes all previously held permits for wastewater discharge from the Rocketdyne Division, SSFL. This permit covers discharge of overflow and storm runoff from water reclamation retention ponds into Bell Creek. Discharge generally occurs only during and immediately after periods of heavy rainfall or during extended periods of rocket engine testing.

Only one of the retention ponds receives influent directly from the ESG-SSFL site. It is identified as retention pond R-2A, Water Sample Station W-12 in Table 8. The influent includes sewage treatment plant outfall and surface runoff water. Grab-type water samples, taken at the retention pond prior to a discharge, are analyzed for nonradioactive chemical constituents and for radioactivity by a California State certified analytical testing laboratory. The specific constituents analyzed for, and their respective limitations in discharged wastewater, are presented in Appendix B. Wastewater originating from facilities located throughout the SSFL site is collected at the retention pond. The point

of origin of nonradioactive constituents normally found in wastewater is impossible to determine; however, in the event of excessive amounts of any of these materials in wastewater, the origin could be determined from the knowledge of facility operations involving their use. Eight off-site discharges of wastewater from Pond R-2A occurred during 1981.

IV. EFFLUENT MONITORING PROGRAM

Effluents that may contain radioactive material are generated at ESG facilities as the result of operations performed under contract to DOE, under NRC Special Nuclear Materials License SNM-21, and under State of California Radioactive Material License 0015-70. The specific facilities are identified as Buildings 001 and 004 at the De Soto site, and Buildings 020, 021, 022, and 055 at the Santa Susana site, SSFL.

A. TREATMENT AND HANDLING

Waste streams released to unrestricted areas are limited, in all cases, to gaseous emissions. No contaminated liquids are discharged to unrestricted areas.

The level of radioactivity contained in all atmospheric emissions is reduced to the lowest values by passing the emissions through certified, high-efficiency particulate air (HEPA) filters. These emissions are sampled for particulate radioactive materials by means of continuously operating stack exhaust samplers at the points of release. In addition, stack monitors installed at Buildings 020 and 055 provide automatic alarm capability in the event of the release of gaseous or particulate activity from Building 020 and particulate activity from Building 055. The HEPA filters used for filtering gaseous emissions are at least 99.97% efficient for particles of 0.3-μm diameter. Particle filtration efficiency increases for particles above and below this size.

The average concentration and total radioactivity in gaseous emissions to unrestricted areas are shown in Table 10. The effectiveness of the air cleaning systems is evident from the fact that, in most cases, the gaseous emissions are less radioactive than is ambient air. The total shows that no significant quantities of radioactivity were released in 1981.

Liquid wastes released to sanitary sewage systems, a controlled area as provided for by CAC 17 and 10 CFR 20, are generated at the De Soto site only.

TABLE 10

ATMOSPHERIC EMISSIONS TO UNRESTRICTED AREAS – 1981

Building	Approximate Emissions Volume (ft^3)	Activity Monitored	Approximate Minimum Detection Level ($\mu Ci/ml$)	Annual Average Concentration ($\mu Ci/ml$)	Sampling Period Maximum Observed Concentration ($\mu Ci/ml$)	Total Radioactivity Released (Ci)	% of Guide[a]	% of Samples with Activity <MDL
001 De Soto	1.4×10^{10}	α	1.6×10^{-16}	$<6.8 \times 10^{-15}$	5.0×10^{-14}	$<2.8 \times 10^{-6}$	<0.23	35
		β	5.4×10^{-16}	$<6.7 \times 10^{-15}$	4.7×10^{-14}	$<2.7 \times 10^{-6}$	<0.002	35
004 De Soto	3.1×10^{10}	α	2.1×10^{-16}	$<4.4 \times 10^{-16}$	2.1×10^{-15}	$<3.9 \times 10^{-7}$	<0.01	56
		β	7.2×10^{-16}	$<4.7 \times 10^{-15}$	2.3×10^{-14}	$<4.1 \times 10^{-6}$	<0.002	12
020 SSFL	1.0×10^{10}	α	0.9×10^{-16}	$<2.3 \times 10^{-16}$	8.7×10^{-16}	$<6.9 \times 10^{-8}$	<0.38	32
		β	3.0×10^{-16}	4.6×10^{-14}	1.7×10^{-13}	1.4×10^{-5}	0.15	0
021-022 SSFL	1.2×10^{10}	α	0.9×10^{-16}	$<2.5 \times 10^{-16}$	1.4×10^{-15}	$<8.7 \times 10^{-8}$	<0.42	38
		β	3.0×10^{-16}	1.2×10^{-14}	3.4×10^{-14}	4.0×10^{-6}	0.04	0
055 SSFL	7.0×10^{9}	α	2.9×10^{-16}	$<2.9 \times 10^{-16}$	6.6×10^{-16}	$<5.9 \times 10^{-8}$	<0.48	88
		β	9.6×10^{-16}	9.8×10^{-15}	4.2×10^{-14}	2.0×10^{-6}	<0.003	0
Annual average ambient air radioactivity concentration ($\mu Ci/ml$) – 1981		α		$<6.8 \times 10^{-15}$	Total	$<3.0 \times 10^{-5}$		
		β		$<1.2 \times 10^{-13}$				

[a]Guide: De Soto site, 3×10^{-12} $\mu Ci/ml$ alpha, 3×10^{-10} $\mu Ci/ml$ beta, 10 CFR 20 Appendix B.
SSFL site, 6×10^{-14} $\mu Ci/ml$ alpha, 3×10^{-11} $\mu Ci/ml$ beta, 3×10^{-12} $\mu Ci/ml$ beta (055 only); 10 CFR 20 Appendix B, *CAC-17*, and *DOE Order 5480.1 Chapter XI.*

Note: All release points are at the Stack Exit.

Liquid wastes are discharged from Building 001 following analysis for radioactivity concentration. There is no continuous flow. Building 004 chemical wastes are released to an automatic discharge cycle retention tank system, which periodically samples and composites aliquots of the tank contents prior to each discharge of a fixed volume of wastewater to the facility sanitary sewerage. No radioactive liquid effluents are released from Santa Susana Buildings 020, 021, 022, or 055. Liquid radioactive waste generated at SSFL is solidified for land burial. The average concentration and total radioactivity in effluents discharged are shown in Table 11.

B. ENERGY SYSTEMS GROUP FACILITY DESCRIPTIONS

1. De Soto Site

a. Building 001 — NRC and California State Licensed Activities

Operations at Building 001 that may generate radioactive effluents consist of production operations associated with the manufacture of enriched uranium fuel elements. Only atmospheric emissions are released from the building to uncontrolled areas. Following analysis for radioactivity concentration, liquid wastes are released to the sanitary sewage system, which is considered a controlled area, as provided by CAC 17 and 10 CFR 20. Nuclear fuel material handled in unencapsulated form in this facility contains the uranium isotopes U^{234}, U^{235}, U^{236}, and U^{238}.

b. Building 004 — NRC and California State Licensed Activities

Operations at Building 004 that may generate radioactive effluents consist of research studies in physical chemistry, and the chemical analysis of small quantities of fuel materials, usually limited to a few grams. Only atmospheric emissions are released from the building to uncontrolled areas. Liquid laboratory wastes are released to an interim retention tank installation. Aliquots

TABLE 11

LIQUID EFFLUENT DISCHARGED TO SANITARY SEWER — 1981

Building	Point of Release	Approximate Effluent Volume (gal)	Activity Monitored	Approximate MDL (μCi/ml)	Annual Average Concentration (μCi/ml)	Sample Maximum Observed Concentration (μCi/ml)	Total Radioactivity Released (Ci)	% of Guide[b]
001	Retention tank	25,500	α	1.0×10^{-9}	1.8×10^{-7}	5.4×10^{-7}	9.3×10^{-6}	0.020
			β	3.7×10^{-9}	9.6×10^{-8}	1.8×10^{-7}	1.7×10^{-5}	0.010
004	Flow sampler	1,516,000	α	1.1×10^{-9}	$<1.3 \times 10^{-8}$[c]	7.0×10^{-8}	7.5×10^{-5}	0.001
			β	3.7×10^{-9}	$<3.7 \times 10^{-8}$[c]	1.6×10^{-7}	2.1×10^{-4}	0.004
020[a]	—	0	—	—	—	—	—	—
021-022[a]	—	0	—	—	—	—	—	—
055[a]	—	0	—	—	—	—	—	—

[a] All liquid radioactive wastes are solidified and land buried as dry waste.
[b] Guide: 9×10^{-4} μCi/ml alpha, 1×10^{-3} μCi/ml beta; 10 CFR 20 Appendix B, CAC-17
[c] % of samples <MDL: 59.7% alpha activity, 47.8% beta activity
Note: The average radioactivity concentration in De Soto site domestic water supplied by the Los Angeles City Department of Water and Power during 1981 was 3.7×10^{-10} μCi/ml alpha and 3.8×10^{-9} μCi/ml beta.

from the tank are composited and analyzed for radioactivity. Nuclear fuel material handled in unencapsulated form in this facility contains the uranium isotopes U^{234}, U^{235}, U^{236}, and U^{238}. Major quantities of other radionuclides in encapsulated form include Co^{60} and Pm^{147}. No significant quantities of these radionuclides were released.

2. Santa Susana Field Laboratories Site

a. Building 020 — NRC and California State Licensed Activities

Operations at Building 020 that may generate radioactive effluents consist of hot cell examination of irradiated nuclear fuels and reactor components. Only atmospheric emissions are released from the building to uncontrolled areas. The discharge may contain particulate material, as well as radioactive gases, depending on the operations being performed and the history of the irradiated fuel or other material. The chemical form of such materials may be U metal, UO_2, UC, mixed fission products, and various activation products. No radioactive liquid waste is released from the facility. Radioactive material handled in unencapsulated form in this facility includes the following radionuclides: Th^{232}, U^{233}, U^{234}, U^{235}, U^{236}, and U^{238}, as constituents in the various fuel materials; and Cs^{137}, Sr^{90}, Kr^{85}, and Pm^{147} as mixed fission products.

b. Buildings 021 and 022 — DOE Contract Activities

Operations at Buildings 021 and 022 that may generate radioactive effluents consist of the processing, packaging, and temporary storage of liquid and dry radioactive waste material for disposal. Only atmospheric emissions are released from the building to uncontrolled areas. No radioactive liquid waste is released from the facility. Nuclear fuel material handled in encapsulated or unencapsulated form contains the uranium isotopes U^{234}, U^{235}, U^{236}, and U^{238}, plus Cs^{137}, Sr^{90}, and Pm^{147} as mixed fission products.

c. Building 055 — NRC and California State Licensed Activities

Operations at Building 055 that may generate radioactive effluents consist of fabricating depleted uranium carbide fuel pellets and converting UC waste to the oxide state. Only atmospheric emissions are released from the facility to uncontrolled areas. No radioactive liquid waste is released from the facility.

The various fuel materials (depleted and enriched uranium and plutonium) contain the following radionuclides: U^{234}, U^{235}, U^{236}, U^{238}, Pu^{238}, Pu^{239}, Pu^{240}, Pu^{241}, and Am^{241}.

C. ESTIMATION OF GENERAL POPULATION DOSE ATTRIBUTABLE TO ESG OPERATIONS — 1981

The release of airborne material at the De Soto site for summer season weather conditions would generally be under a subsidence inversion into an atmosphere that is typical of slight neutral to lapse conditions. Nocturnal cooling inversions, although present, are relatively shallow in extent. During the summer, a subsidence inversion is present almost every day. The base and top of this inversion usually lie below the elevation of the SSFL site. Thus, any atmospheric release from the SSFL site under this condition would result in Pasquill Type D lofting diffusion conditions above the inversion and considerable atmospheric dispersion, prior to any diffusion through the inversion into the Simi or San Fernando Valleys. In the winter season, the Pacific high-pressure cell shifts to the south and the subsidence inversion is usually absent. The surface air flow is then dominated by frontal activity moving through the area or to the east, resulting in high-pressure systems in the great basin region. Frontal passages through the area during winter are generally accompanied by precipitation. Diffusion characteristics are highly variable depending on the location of the front. Generally, a light to moderate southwesterly wind precedes these frontal passages, introducing a strong onshore flow of marine air and lapse rates that are slightly neutral. Wind speeds increase as the frontal systems approach, enhancing diffusion. The diffusion characteristics of the frontal passage are lapse conditions with light to moderate northerly winds. Locally,

average windspeeds for the various stability categories range from 0 to about 4.4 m/s with the greatest frequency occurring for winds from the north to northwest sectors. Local population distribution estimates for 1981, based on the 1980 federal census, for areas surrounding the De Soto and SSFL sites and out to 80 km for 16 sectors are shown in Tables 12 and 13.

The downwind concentration of radioactive material emissions to the atmosphere during 1981 from each of the four major ESG nuclear facilities has been calculated with the AIRDOS-EPA computer code using site-specific input data.

To determine the nearest site boundary and nearest residence maximum radioactivity concentrations, a mean wind speed of 2.2 m/s for each stability class was selected to evaluate the plume centerline (maximum) concentrations toward the sector in which those locations lie. The 80-km concentration is not direction specific, but is given for comparison with the nearby concentration values. These are shown in Table 14.

The general population man-rem dose estimates are calculated from the demographic distribution and the sector total inhalation intake man pCi/year generated by AIRDOS-EPA, which uses release rate, wind speed, wind direction and frequency, inversion, lapse, and effective stack height parameters as input data. Population dose estimates are presented in Tables 15 and 16 for the De Soto and SSFL sites. The exposure mode is by inhalation with lung the critical organ for U^{235}, U^{238}, and Pu^{239}, and bone for Sr^{90}. The doses reported for SSFL site emissions are summed for all release points and nuclides.

TABLE 12

DE SOTO SITE DEMOGRAPHY – 1981

(34^{o} 13' 54" N. 118^{o} 35' 12" W)

22.5^{o} Sector	Centered Azimuth Direction Toward (deg)	0-1.6 km	1.6-3.2 km	3.2-4.8 km	4.8-6.4 km	6.4-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	0	0	527	3,437	8	0	2,483	31,112	5,718	738	2,444	46,467
NNE	22-1/2	1,407	4,360	4,542	4,550	10,388	5,022	22,207	6,734	25,388	42,248	126,846
NE	45	126	3,616	4,391	3,181	10,563	64,364	18,639	5,383	21,750	6,932	138,945
ENE	67-1/2	0	0	7,263	4,551	7,499	107,317	87,278	3,078	271	552	217,809
E	90	2,701	4,204	6,088	8,807	13,290	111,190	277,042	470,238	492,682	368,758	1,755,000
ESE	112-1/2	1,430	2,455	7,169	9,837	11,371	78,493	478,488	1,151,795	811,774	852,309	3,405,121
SE	135	1,324	4,045	8,717	10,886	16,600	35,573	410,956	795,894	773,769	229,030	2,286,794
SSE	157-1/2	929	7,681	9,530	2,543	8,131	6,519	87,880	0	55,599	0	178,812
S	180	0	5,744	3,743	2,309	5,549	17,658	7,554	0	0	0	42,557
SSW	202-1/2	4,384	3,778	7,330	9,866	9,330	15,514	4,905	0	0	0	55,107
SW	225	3,697	2,633	6,863	3,614	9,768	3,139	27,213	969	0	0	57,896
WSW	247-1/2	0	5,295	1,189	4,232	4	0	82,022	39,794	136,563	0	269,099
W	270	0	0	897	51	0	26,335	38,145	49,946	84,637	34,472	234,483
WNW	292-1/2	0	2,106	0	0	564	26,119	809	12,534	1,887	1,556	45,575
NW	315	0	7,561	0	0	0	97	1,565	0	241	1,987	11,451
NNW	337-1/2	0	2,861	2,004	392	0	414	16,387	4,449	280	288	27,075
	Total	15,998	56,866	73,163	64,827	103,057	500,237	1,592,202	2,546,532	2,405,579	1,540,576	8,899,037

TABLE 13

SANTA SUSANA FIELD LABORATORIES SITE DEMOGRAPHY – 1981
(34° 13' 50" N. 118° 32' 47" W)

22.5° Sector	Centered Azimuth Direction Toward (deg)	0-1.6 km	1.6-3.2 km	3.2-4.8 km	4.8-6.4 km	6.4-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	0	0	0	2,436	3,597	7,682	97	16,387	4,449	730	89	35,467
NNE	22-1/2	0	0	0	8,350	2,468	41	33,977	8,274	3,815	24,562	81,487
NE	45	0	1,209	0	564	0	392	26,411	9,844	4,270	63,563	106,253
ENE	67-1/2	0	0	0	51	883	45,597	264,064	58,027	10	1,219	369,851
E	90	0	0	0	2,107	5,661	111,226	405,120	522,360	692,884	581,012	2,320,370
ESE	112-1/2	0	0	0	548	8,346	53,282	138,131	1,189,218	1,180,366	1,015,060	3,584,951
SE	135	0	0	0	0	0	18,022	80,026	177,617	515,221	200,041	990,927
SSE	157-1/2	0	0	0	113	3,025	0	5,183	0	0	0	8,321
S	180	0	0	0	0	0	8,876	4,134	0	0	0	13,010
SSW	202-1/2	0	0	0	4,396	0	10,474	6,638	0	0	0	21,508
SW	225	0	0	0	0	0	15,395	1,125	0	0	0	16,520
WSW	247-1/2	0	0	0	0	0	38,005	58,298	135,222	3,195	0	234,720
W	270	0	0	0	0	0	3,982	28,824	77,255	42,697	13,212	165,970
WNW	292-1/2	0	0	2,914	3,145	14,747	3,237	7,964	12,288	18,433	0	62,728
NW	315	0	0	4,093	13,753	4,001	0	7,861	0	241	618	30,567
NNW	337-1/2	0	0	0	6,144	3,257	607	1,565	0	0	2,186	13,759
	Total	0	1,209	9,443	42,768	50,070	309,233	1,085,708	2,194,554	2,461,862	1,901,502	8,056,409

TABLE 14

MAXIMUM DOWNWIND PLUME CENTERLINE CONCENTRATIONS
OF GASEOUS EMISSIONS – 1981

Facility	Release Rate (Ci/year)	Distance (m) to		Downwind Concentration ($\mu Ci/cm^3$)[a]		
		Boundary	Residence	Boundary	Residence	80-km
B/001	5.5×10^{-6}	110 W	171 SW	4.5×10^{-17}	4.9×10^{-17}	1.6×10^{-19}
B/020	1.4×10^{-5}	305 NW	1900 SE	1.9×10^{-17}	9.9×10^{-18}	3.4×10^{-19}
B/022	4.1×10^{-6}	350 NW	2300 SE	1.8×10^{-18}	1.5×10^{-18}	8.6×10^{-20}
B/055	1.2×10^{-6}	400 NW	1830 SE	3.5×10^{-18}	1.1×10^{-18}	2.7×10^{-20}

[a]Assume $\bar{u}$ = 2.2 m/s average wind speed, constant direction, full year.

The off-site doses are extremely low compared to the maximum permissible exposures recommended for the general population. These values are 3 Rem/year for bone and 1.5 Rem/year for the lung for an individual, and they are one-third of these values for the general population. The highest average individual dose for 1981 is for the De Soto 0-8 km segment, which is equivalent to an average dose/man·year of 0.0002 mRem, or 0.00004% of the maximum permissible exposure for an individual and 0.00012% of the general population exposure limit. Estimated radiation doses due to atmospheric emission of radioactivity from ESG facilities are a small fraction of the recommended limits and are far below doses due to internal deposition of natural radioactivity in air, which is approximately 50 to 100 mRem/year.

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TABLE 15

POPULATION DOSE ESTIMATES FOR ATMOSPHERIC EMISSIONS
FROM THE DE SOTO FACILITY – 1981

22.5^{0} Sector	Dose to Receptor Population Segment (man-Rem)						
	0-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	1.5×10^{-3}	1.8×10^{-4}	1.0×10^{-3}	1.2×10^{-4}	1.2×10^{-5}	3.1×10^{-5}	2.8×10^{-3}
NNW	1.5×10^{-3}	1.9×10^{-5}	3.4×10^{-4}	5.9×10^{-5}	2.7×10^{-6}	2.2×10^{-6}	1.9×10^{-3}
NW	2.7×10^{-3}	4.4×10^{-6}	3.2×10^{-5}	0	2.3×10^{-6}	1.5×10^{-5}	2.8×10^{-3}
WNW	1.6×10^{-3}	2.4×10^{-3}	3.4×10^{-5}	3.4×10^{-4}	3.7×10^{-5}	2.4×10^{-5}	4.4×10^{-3}
W	2.4×10^{-4}	1.5×10^{-3}	9.9×10^{-4}	8.3×10^{-4}	1.0×10^{-3}	3.2×10^{-4}	4.9×10^{-3}
WSW	1.8×10^{-3}	0	1.1×10^{-3}	3.5×10^{-4}	8.8×10^{-4}	0	4.1×10^{-3}
SW	3.6×10^{-3}	7.3×10^{-5}	2.9×10^{-4}	6.6×10^{-6}	0	0	4.0×10^{-3}
SSW	5.1×10^{-3}	3.9×10^{-4}	5.7×10^{-5}	0	0	0	5.5×10^{-3}
S	4.2×10^{-3}	9.4×10^{-4}	1.8×10^{-4}	0	0	0	5.3×10^{-3}
SSE	9.0×10^{-3}	4.0×10^{-4}	2.5×10^{-3}	0	7.3×10^{-4}	0	1.3×10^{-2}
SE	9.9×10^{-3}	2.1×10^{-3}	1.1×10^{-2}	1.4×10^{-2}	9.8×10^{-3}	2.3×10^{-3}	4.9×10^{-2}
ESE	6.3×10^{-3}	3.6×10^{-3}	1.0×10^{-2}	1.6×10^{-2}	8.1×10^{-3}	6.6×10^{-3}	5.1×10^{-2}
E	5.5×10^{-3}	4.6×10^{-3}	4.2×10^{-3}	4.5×10^{-3}	3.5×10^{-3}	2.0×10^{-3}	2.4×10^{-2}
ENE	1.4×10^{-3}	2.4×10^{-3}	9.1×10^{-4}	2.1×10^{-5}	1.3×10^{-6}	2.1×10^{-6}	4.7×10^{-3}
NE	2.6×10^{-3}	2.0×10^{-3}	2.6×10^{-4}	4.9×10^{-5}	1.5×10^{-4}	3.6×10^{-5}	5.1×10^{-3}
NNE	5.5×10^{-3}	2.3×10^{-4}	4.6×10^{-4}	9.0×10^{-5}	2.5×10^{-4}	3.2×10^{-4}	6.8×10^{-3}
Total	6.2×10^{-2}	2.1×10^{-2}	3.3×10^{-2}	3.6×10^{-2}	2.4×10^{-2}	1.2×10^{-2}	1.9×10^{-1}

1. Average individual dose = 2.1×10^{-8} Rem for the total population of 80-km radius area.
2. Total 80-km radius man-Rem dose estimate from naturally occurring airborne radioactivity dose to the lung of ∿0.1 Rem/year = 1,000,000 (1.0×10^{6}) man-Rem.

TABLE 16

POPULATION DOSE ESTIMATES FOR ATMOSPHERIC EMISSIONS
FROM SSFL FACILITIES – 1981

22.5^{o} Sector	Dose to Receptor Population Segment (man-Rem)						
	0-8 km	8-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total
N	9.1×10^{-5}	2.1×10^{-7}	1.5×10^{-5}	2.4×10^{-6}	3.1×10^{-7}	2.7×10^{-8}	1.1×10^{-4}
NNW	3.7×10^{-5}	8.1×10^{-7}	9.0×10^{-7}	0	0	4.3×10^{-7}	3.9×10^{-5}
NW	1.5×10^{-4}	0	5.0×10^{-6}	0	2.4×10^{-7}	1.4×10^{-7}	1.6×10^{-4}
WNW	1.6×10^{-4}	9.4×10^{-6}	1.1×10^{-5}	1.0×10^{-5}	1.1×10^{-5}	0	2.0×10^{-4}
W	0	7.1×10^{-6}	2.4×10^{-5}	4.1×10^{-5}	1.6×10^{-5}	4.0×10^{-6}	9.2×10^{-5}
WSW	8.0×10^{-5}	5.5×10^{-5}	5.9×10^{-5}	9.0×10^{-7}	0	0	1.9×10^{-4}
SW	3.4×10^{-5}	0	0	0	0	0	3.4×10^{-5}
SSW	3.7×10^{-5}	0	0	0	0	0	3.7×10^{-5}
S	1.2×10^{-4}	0	0	0	0	0	1.2×10^{-4}
SSE	6.9×10^{-5}	0	0	0	0	0	6.9×10^{-5}
SE	4.6×10^{-5}	0	0	0	0	0	4.6×10^{-5}
ESE	3.3×10^{-4}	2.6×10^{-4}	3.4×10^{-4}	8.6×10^{-5}	0	0	1.0×10^{-3}
E	4.9×10^{-4}	1.2×10^{-3}	5.4×10^{-4}	3.0×10^{-4}	0	0	2.5×10^{-3}
ENE	1.2×10^{-4}	3.4×10^{-4}	2.1×10^{-4}	1.1×10^{-4}	0	0	7.8×10^{-4}
NE	6.6×10^{-4}	5.2×10^{-5}	4.1×10^{-9}	3.2×10^{-7}	0	0	7.1×10^{-4}
NNE	8.6×10^{-5}	1.3×10^{-5}	2.5×10^{-6}	2.3×10^{-5}	0	0	1.2×10^{-4}
Total	2.5×10^{-3}	1.9×10^{-3}	1.2×10^{-3}	5.7×10^{-4}	2.8×10^{-5}	4.6×10^{-6}	6.3×10^{-3}

Average individual dose = 7.8×10^{-10} Rem for the 80-km radius area total population.

APPENDIX A

COMPARISON OF ENVIRONMENTAL RADIOACTIVITY DATA FOR 1981 WITH PREVIOUS YEARS

This section compares environmental monitoring results for calendar year 1981 with previous annual data.

The data presented in Tables A-1 through A-5 summarize all past annual average radioactivity concentrations. These data show the effects of both the short-lived and long-lived radioactive fallout from nuclear weapons tests superimposed on the natural radioactivity inherent in the various sample types.

Over the considerable period of time that the environmental program has been in operation, evolutionary changes have been made in order to provide more effective data. In some cases, this is readily apparent in the data. For example, in Table A-1, a small but abrupt increase in the alpha activity reported for soil occurs in 1971. This increase, which is observed in both the on-site and the off-site samples, resulted from use of an improved counting system with a thinner sample configuration. The thinner sample increases the sensitivity of the detector to alpha-emitting radionuclides in the sample, thus producing a higher measured specific radiation.

Similarly, prior to 1971, gross activity in ambient air was measured, including both alpha and beta activity. In 1971, measurements were begun which allowed separate identification of these two types of radiation.

For all types of samples, the data indicate that there is no concentrated local source of unnatural radioactivity in the environment. Also, the similarity between onsite and offsite results further indicate that ESG operations contribute essentially nothing to general environmental radioactivity.

TABLE A-1

SOIL RADIOACTIVITY DATA — 1957 THROUGH 1981

Year	Onsite-Average (10^{-6} μCi/g)			Offsite-Average (10^{-6} μCi/g)		
	Number Samples	α	β	Number Samples	α	β
1981	144	0.69	25	48	0.64	23
1980	144	0.60	24	48	0.58	23
1979	144	0.64	25	48	0.50	23
1978	144	0.63	24	48	0.51	24
1977	144	0.56	24	48	0.53	23
1976	144	0.56	25	48	0.56	24
1975	144	0.60	25	48	0.58	24
1974	144	0.60	25	48	0.54	24
1973	144	0.57	25	48	0.51	24
1972	144	0.56	25	48	0.57	24
1971	144	0.55	25	48	0.53	23
1970	144	0.47	27	48	0.48	25
1969	144	0.42	27	48	0.42	25
1968	144	0.47	26	48	0.48	26
1967	144	0.42	28	48	0.39	24
1966	144	0.41	29	48	0.44	25
1965	144	0.46	36	142	0.47	29
1964	152	0.46	32	299	0.44	26
1963	156	0.43	45	455	0.42	42
1962	147	0.44	48	453	0.41	47
1961	120	0.37	34	458	0.33	23
1960	115	0.41	23	362	0.37	19
1959	107	0.43	15	377	0.32	14
1958	80	0.27	21	309	0.26	10
1957	64	0.32	11	318	0.35	10

TABLE A-2

VEGETATION RADIOACTIVITY DATA — 1957 THROUGH 1981

Year	Onsite-Average (10^{-6} µCi/g ash)			Offsite-Average (10^{-6} µCi/g ash)		
	Number Samples	α	β	Number Samples	α	β
1981	144	<0.20	137	48	<0.21	129
1980	144	<0.25	160	48	<0.19	142
1979	144	<0.24	139	48	<0.23	134
1978	144	<0.24	166	48	<0.24	143
1977	144	<0.22	162	48	<0.21	142
1976	144	<0.19	170	48	<0.22	147
1975	144	<0.21	155	48	<0.21	141
1974	144	<0.20	152	48	<0.27	141
1973	144	<0.24	155	48	<0.24	142
1972	144	0.23	145	48	0.36	125
1971	144	0.24	165	48	0.31	132
1970	144	0.33	159	48	0.30	142
1969	144	0.40	165	48	0.36	144
1968	144	0.51	158	48	0.51	205
1967	144	0.62	286	48	0.39	413
1966	144	0.37	169	48	0.37	123
1965	144	0.56	162	142	0.61	138
1964	154	0.50	211	293	0.51	181
1963	156	0.44	465	456	0.37	388
1962	147	0.45	500	453	0.44	406
1961	120	0.35	224	459	0.29	246
1960	115	0.35	137	362	0.25	136
1959	96	0.29	212	293	0.18	168
1958	65	0.57	683	250	0.39	356
1957	58	1.1	208	304	0.89	200

TABLE A-3

SSFL SITE DOMESTIC WATER RADIOACTIVITY DATA — 1957 THROUGH 1981

Year	Number Samples	Average α (10^{-9} μCi/ml)	Average β (10^{-9} μCi/ml)
1981	24	<0.24	2.8
1980	24	<0.22	2.4
1979	24	<0.23	2.8
1978	24	<0.26	3.0
1977	24	<0.25	2.5
1976	24	<0.25	2.0
1975	24	<0.24	2.3
1974	24	<0.24	2.7
1973	24	<0.26	3.4
1972	24	0.22	3.7
1971	24	0.28	4.9
1970	24	0.18	5.3
1969	24	0.11	5.0
1968	24	0.16	5.0
1967	24	0.13	6.1
1966	24	0.13	4.6
1965	24	0.22	6.0
1964	23	0.18	5.3
1963	24	0.18	7.0
1962	24	0.21	12.0
1961	24	0.08	2.9
1960	22	0.08	1.9
1959	18	0.08	1.6
1958	13	0.16	4.7
1957	17	-	13.0

TABLE A-4

BELL CREEK AND ROCKETDYNE DIVISION RETENTION POND RADIOACTIVITY DATA — 1966 THROUGH 1981

Year	Samples														
	Bell Creek Mud 54			Bell Creek Vegetation 54			Bell Creek Water 16			Interim Retention Pond Water 6			Final Retention Pond R-2A Water 12		
	No. of Samples	Average (10^{-6} µCi/g)		No. of Samples	Average (10^{-6} µCi/g ash)		No. of Samples	Average (10^{-9} µCi/ml)		No. of Samples	Average (10^{-9} µCi/ml)		No. of Samples	Average (10^{-9} µCi/ml)	
		α	β		α	β		α	β		α	β		α	β
1981	12	0.58	24.	12	<0.13	103.	12	<0.23	3.8	12	<0.23	4.3	12	<0.25	5.2
1980	12	0.51	23.	12	<0.18	150.	12	<0.22	2.9	12	<0.22	2.9	12	<0.22	3.9
1979	12	0.46	23.	12	<0.26	136.	12	<0.23	3.2	12	<0.25	3.1	12	<0.23	4.5
1978	12	0.42	23.	12	<0.26	156.	12	<0.24	2.5	12	<0.25	4.3	12	<0.25	4.6
1977	12	0.29	22.	12	<0.19	155.	12	<0.24	1.8	12	<0.24	4.3	12	<0.25	5.2
1976	12	0.38	23.	12	<0.17	164.	12	<0.25	2.2	12	<0.24	4.3	12	<0.28	4.4
1975	12	0.29	22.	12	<0.19	123.	12	<0.22	2.4	12	<0.24	4.2	12	<0.31	4.5
1974	12	0.32	22.	12	<0.16	142.	12	<0.21	2.5	12	<0.22	4.2	12	<0.21	4.5
1973	12	0.34	24.	12	<0.17	147.	12	<0.21	2.7	12	<0.23	4.5	12	<0.37	5.6
1972	12	0.32	22.	12	0.12	139.	12	0.20	2.5	12	0.22	5.3	12	0.22	5.5
1971	12	0.36	23.	12	0.19	128.	12	0.15	3.8	12	0.18	6.2	12	0.16	6.4
1970	12	0.44	24.	12	0.23	165.	12	0.15	3.7	12	0.15	6.9	12	0.12	7.4
1969	12	0.35	27.	12	0.28	166.	12	0.04	4.0	12	0.07	5.9	11	0.10	5.7
1968	11	0.32	24.	11	0.39	170.	8	0.05	4.6	11	0.23	8.1	12	0.33	7.7
1967	12	0.40	24.	12	0.38	180.	12	0.07	5.8	12	0.19	6.6	10	0.17	7.0
1966	3	0.39	25.	3	1.1	108.	3	0.75	2.5	9	0.11	5.8	8	1.1	6.3

TABLE A-5

AMBIENT AIR RADIOACTIVITY CONCENTRATION DATA —
1957 THROUGH 1981

Year	De Soto Site Average (10^{-12} µCi/ml)			SSFL Site Average[a] (10^{-12} µCi/ml)		
	Number Samples	α	β	Number Samples	α	β
1981	704	<0.0069	<0.12	2518	<0.0068	<0.12
1980	685	<0.0065	<0.039	2342	<0.0064	<0.035
1979	697	<0.0066	<0.021	2519	<0.0065	<0.020
1978	713	<0.0084	<0.091	2402	<0.0072	<0.088
1977	729	<0.0066	<0.17	2438	<0.0066	<0.17
1976	719	<0.0067	<0.096	2520	<0.0065	<0.11
1975	709	<0.0063	<0.076	2450	<0.0060	<0.073
1974	663	<0.0056	<0.16	2477	<0.0057	<0.16
1973	715	<0.0075	<0.041	2311	<0.0072	<0.038
1972	708	0.0085	0.14	2430	0.0086	0.14
1971[b]	730	0.0087	0.30	2476	0.0086	0.33
1970	668	-	0.34	2434	-	0.36
1969	687	-	0.27	2364	-	0.26
1968	650	-	0.32	2157	-	0.32
1967	712	-	0.39	2400	-	0.41
1966	706	-	0.18	2205	-	0.17
1965	483	-	0.83	1062	-	0.21
1964	355	-	2.7	-		c
1963	360	-	6.6	292	-	4.7
1962	343	-	7.3	314	-	5.6
1961	313	-	4.2	176	-	3.6
1960	182	-	0.24	44	-	0.44
1959	215	-	2.5	257	-	0.93
1958	366	-	4.9	164	-	2.7
1957	63	-	1.6	141	-	2.7

[a] Includes Rocketdyne Site Air Sampler Data
[b] Ambient air alpha radioactivity values were included in the beta values and not reported separately prior to 1971
[c] Insufficient data

APPENDIX B

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD CRITERIA FOR DISCHARGING NONRADIOACTIVE CONSTITUENTS FROM ROCKETDYNE DIVISION, SSFL

The discharge of an effluent in excess of the limits given in Table B-1 is prohibited.

TABLE B-1

NPDES NO. CA00-01309, EFFECTIVE 27 SEPTEMBER 1976

Constituent	Discharge Rate (lb/day)	Concentration Limit (mg/liter)	
	30-day Average	30-day Average	Maximum
Total dissolved solids	1,267,680	-	950
Chloride	200,160	-	150
Sulfate	400,320	-	300
Suspended solids[a]	66,720	50	150
Settleable solids[a]	-	0.1	0.3
BOD_5	26,690	20	60
Oil and grease	13,350	10	15
Chromium	6.67	0.005	0.01
Fluoride	1,340	-	1.0
Boron	1,340	-	1.0
Residual chlorine	-	-	0.1
Fecal coliform (MPN/100 ml)	-	-	23.0
Surfactants (as MBAS)	667	-	0.5
pH			6.0-9.0

[a]Not applicable to discharges containing rainfall runoff during or immediately after periods of rainfall.

APPENDIX C
REFERENCES

1. DOE Order 5484.1
2. DOE Order 5480.1
3. Code of Federal Regulations, Title 10, Part 20
4. California Radiation Control Regulations, California Administrative Code, Title 17, Public Health
5. California Regional Water Quality Control Board, Los Angeles Region, Order No. 74-379, NPDES No. CA0001309, Effective 27 September 1976
6. AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Doses to Man from Airborne Releases of Radionuclides, ORNL-5532
7. Estimates of Internal Dose Equivalent to 22 Target Organs for Radionuclides Occurring in Routine Releases from Nuclear Fuel Cycle Facilities, Volume III, ORNL/NUREG/TM-190

APPENDIX D
EXTERNAL DISTRIBUTION

1. Radiologic Health Section, State Department of Public Health, California
2. Radiological Health Division, Los Angeles County Health Department, California
3. Resources Management Agency, County of Ventura, California
4. U.S. Department of Energy, San Francisco Operations Office
5. U.S. Nuclear Regulatory Commission, Division of Reactor Licensing
6. Gordon Facer, Division of Military Applications, DOE
7. Andrew J. Pressesky, Reactor Research and Development, DOE
8. James Miller, Divsion of Biomedical and Environmental Research, DOE
9. DOE-Headquarters Library, Attention: Charles Sherman

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Canoga Park, California 91304